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Observations on the Capelin Stock in Div. 2J3K

by

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Abstract

A review of stock discrimination, catches, biological advice and management of capelin stocks in the most heavily fished areas, NAFO Div. 2J3KLNO are presented. A more detailed account of past assessments of the Div. 2J3K capelin stock is reviewed. Most of the past assessments of the Div. 2J3K capelin stock have been related to the offshore fishery but with the decline of this fishery and the increase in interest in an inshore fishery, more research data are now being collected on this inshore fishery. Most of the inshore fishing and research effort is centred in Div. 3L although a concerted effort is now being made to collect information from the inshore fishery in Div. 3K. This research information is derived from commercial catch sampling and from logbooks and the data collected to date are presented.

Résumé

Ce qui suit est une revue de la séparation des stocks de capelans, des prises et conseils biologiques et de gestion dans les régions les plus fortement exploitées, soit les div. 2J3KLNO de l'OPANO. Un compte rendu plus détaillé des évaluations du stock des div. 2J3K est également examiné. La plupart des évaluations passées de ce dernier stock se rapportaient à la pêche hauturière. Cependant, à la suite du déclin de la pêcherie hauturière et de l'intérêt croissant à l'endroit de la pêche côtière, plus de données sont maintenant recueillies sur la pêche côtière. La majeure partie de la pêche côtière et de la recherche est concentrée dans la div. 3L, mais on tâche actuellement d'étendre la collecte des données à la pêche côtière de la div. 3K. Ces données découlent surtout de l'échantillonnage des prises commerciales et de l'examen des journaux de bord, et nous présentons l'information recueillie à ce jour.

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Introduction

It is probable that capelin, Mallotus villosus, is one of the most important fish species in the Northwest Atlantic because of its position as a forage species (Bailey et al. 1977; Winters and Carscadden 1978) and its commercial importance. This position as an important forage and commercial species has created controversy over the years; for instance, as early as 1835 fishermen complained that the "hauling of capelin for manure had proved very prejudicial to the success of the cod fishery" (Journal of the Newfoundland House of Assembly 1835). In the last decade, capelin has generated a great deal of interest both from the general public and the scientific community. This interest arose largely because of a large commercial capelin fishery that developed in the early 1970's and the potential impact of this fishery on the capelin stocks themselves and on predator stocks, many of which are commercially important.

It is only in the last decade that man has become a significant predator of capelin although capelin have been taken during the spawning season for decades. It has been estimated that prior to the 1950's 20,000-25,000 t of capelin were taken annually in Newfoundland for bait and fertilizer and to a lesser extent for food for dog teams (Templeman 1968; Barnes 1974). However, with the decline in the use of dog teams and fertilizer for gardens and less demand for capelin as bait, inshore landings declined considerably. During the 1970's, interest in capelin as a commercial species increased with effort being concentrated in the offshore area in the early and mid 1970's and in the inshore area in the late 1970's.

This paper reviews stock discrimination of capelin and the capelin fishery and its management in Div. 2J3KLNO. In addition, more detailed information is presented on the offshore and inshore fisheries in Div. 2J3K including a history of the assessments of this stock and results of logbook surveys of the inshore fishery.

A. Background on Capelin - Div. 2J3KLNO

Stock Discrimination

The relative distribution of capelin in the Newfoundland coastal zone varies seasonally but undoubtedly peaks in June and July, when beach spawning occurs. At other times of the year, capelin can be found in large concentrations in the offshore waters. While the distribution of young capelin is not well defined, the distribution and migration patterns of adults are better known and spawning stocks of capelin have been tentatively identified. There are five major stocks in the Newfoundland area: Labrador-northeast Newfoundland stock, NAFO Div. 2J3K, (A); northern Grand Bank-Avalon stock, NAFO Div. 3L, (B); south Grand Bank (Southeast Shoal) stock, NAFO Div. 3NO, (C); St. Pierre-Green Bank stock, NAFO Div. 3Ps, (D); Gulf of St. Lawrence stock, (E) (Fig. 1). Some of these major stocks (eg. Labrador-northeast Newfoundland and Gulf of St. Lawrence) may be composed of a number of sub-stocks (Winters 1974; Sharp et al. 1978). These stocks have been identified through the knowledge of seasonal distribution patterns and growth differences (Campbell and Winters 1973; Winters 1982) meristic (Sharp et al. 1978; Carscadden and Misra 1980; Misra and Carscadden 1984), and morphometric (Sharp et al.

1978) characters and the fishing patterns of the commercial capelin fleet. Besides these offshore stocks of capelin that migrate to the inshore areas or Southeast Shoal to spawn, there is also evidence to suggest that there are local stocks, probably relatively low in abundance. Like most species of fish, there is some degree of stock overlap during some part of the life cycle. Since most of the commercial fishery occurred on only three of the stocks (Div. 2J3K, Div. 3L, and Div. 3NO stocks), most of the subsequent discussion will be restricted to capelin occurring in these areas.

The Notre Dame Bay area is known to be an over-wintering area for part of the Labrador-northeast Newfoundland (Div. 2J3K) stock. It seems probable that capelin also over-winter in parts of NAFO Subarea 2; maturing capelin have been taken in research catches late in the year in this area and there is no known northward migration in the spring from Div. 3K to the inshore spawning grounds in Subarea 2. During June and July, mature capelin move inshore to spawn on beaches in northeastern Newfoundland and Labrador. After spawning, most fish die. The few spawning survivors move offshore in the late summer and join immature fish to form feeding schools. Feeding is heavy from August to November and schools are found in offshore waters from Labrador to northeast Newfoundland.

The northern Grand Bank-Avalon (Div. 3L) and Southeast Shoal Div. 3NO) stocks appear to mix and over-winter on the northern part of the Grand Bank (Campbell and Winters 1973; Carscadden and Misra 1980). During late winter and early spring the fish become active, form feeding schools,

and begin a migration to the spawning grounds. The northern Grand Bank-Avalon stock moves inshore to spawn on Newfoundland beaches while the Southeast Shoal stock moves south over the Grand Bank to spawn on sandy substrate on the Southeast Shoal. Spawning in both areas occurs during June and July and post-spawning mortality is high at this time. Spawning survivors are believed to move to the northern Grand Bank area for feeding and over-wintering.

The Fishery and Its Management

In 1972, the first substantial offshore catches of about 70,000 t of capelin were reported. These catches increased rapidly, peaking in 1976 at about 370,000 t and declining since then. The catches were taken at different times of the year in different areas and details of the catches by areas (Div. 3L, Div. 3NO, and Div. 2J3K) are given in Fig. 2, 3, and 4.

The annual offshore capelin fishery normally began in March or April on fish, most of which were maturing and feeding, on the northern Grand Banks (Div. 3L). Thus, fish from two stocks, the northern Grand Bank-Avalon stock and the Southeast Shoal stock, were fished by a fleet dominated by USSR midwater trawlers. The fishing fleet followed the capelin as they moved to their spawning grounds; however, once the inshore spawning component entered Canadian territorial waters, the fleet followed the Southeast Shoal (Div. 3NO) capelin to their spawning grounds where the fishery on spawning capelin continued into July. Most of the vessels operating on the Southeast Shoal were USSR midwater trawlers and Norwegian purse seiners.

The fishery in Div. 3L developed very rapidly with the peak catch reported in 1974, followed by a gradual decline from 1975-80 (Fig. 2). It should be noted that in 1975, Canadian ports were closed to the USSR fishing fleet because Canadian authorities accused the Soviets of taking approximately double their quota in Div. 3L. If true, the catch in 1975 (Fig. 2) should be approximately 60,000 t. In addition, the "inshore" catch in 1974 is shown at approximately 8,000 t, higher than the preceding and following years. This may be an anomaly caused by the grouping of the data; in the present grouping, Canadian catches were assumed to have been taken inshore since Canada has no fleet of large vessels fishing capelin. However, in 1974, some catches were reported from large (500-999 GRT) purse seiners chartered by Canadian companies. Thus, the catches may have been taken offshore and the inshore catch estimates for 1974 may be over-estimated and the offshore catch estimates under-estimated. It should also be noted that each year some unknown fraction of the Div. 3L offshore catch may have been fish from the Southeast Shoal stock. In general, the trend of catches for Div. 3L since 1974 has been a decrease in the offshore portion (offshore fishery closed in 1979) and an increase in the inshore portion. The inshore catch consists of mature capelin and has been taken entirely by Newfoundland fishermen who are attempting to satisfy the Japanese market for roe capelin.

The catches (Fig. 3) of the Southeast Shoal stock (Div. 3NO) rose rapidly from about 21,000 t in 1972 to a level of about 100,000 to 132,000 t for four years between 1973-76 and dropped quickly to 47,000 t in 1977 and 5,000 t in 1978. The fishery was closed in 1979 and has

remained closed since then. It was the conclusion of scientists that "the intense commercial fishery on the spawning grounds in Div. 3N may have substantially reduced the spawning stock size in recent years, and the possibility of recruitment overfishing should be taken into account" (Anon. 1979).

Each year when the fishery on the Southeast Shoal stopped with the cessation of capelin spawning, the attention of the fleet shifted to Div. 2J and Div. 3K in late August or early September. This fishery, which caught feeding capelin most of which would mature and spawn the following year, was prosecuted mainly by USSR midwater trawlers and continued until November or December.

The first large catch in the Div. 2J3K capelin fishery was reported in 1972 at 46,000 t. Catches peaked in 1976 at about 216,000 t and declined after that about 5,000 t in 1980. During the period 1970-80, inshore catches remained at a low level below 2,500 t (Fig. 4).

The management of capelin came under the jurisdiction of ICNAF until Canada extended its fisheries jurisdiction to 200 miles (January 1, 1977). At this time, the Div. 2J3K stock came solely under Canadian management because it occurred completely within Canadian jurisdiction although until 1984 Canada continued to request that biological advice be provided through NAFO. The Div. 3NO stock overlaps the Canadian zone and biological advice and management recommendations have continued under the auspices of NAFO. Biological advice for the Div. 3L stock continues to be provided through NAFO although all of the fishery occurs within the coastal zone. The biological advice provided for the management of

of capelin has, with few exceptions, been adopted by the fisheries managers in NAFO and in Canada and as a result, the biological advice and some of the rationale for the advice are provided below.

The biological advice, provided through ICNAF and later NAFO, was initially requested because of the increasing commercial offshore fishery during the early 1970's. The first advice concerning the total allowable catch (TAC) of capelin pertained to 1974 when it was recommended by the Standing Committee on Research and Statistics (STACRES) of ICNAF that the catch should not exceed 250,000 t. The following year (1975) it was recommended that the total TAC could be increased to 500,000 t and maintained for three years. Furthermore it was noted that the fishery should be restricted to mature capelin approaching and during the spawning season and countries participating in the fishery should conduct surveys of both the adult and juvenile stock to monitor the effect of the fishery. Also in 1975, a crude estimate of relative stock sizes resulted in a recommendation that 300,000 t could be allocated to the northern area (Div. 2J3K) and 200,000 t to the southern area (Div. 3LNOPs). Further subdivision of the northern TAC was not practical at that time due to insufficient knowledge of stock separation. However, there was evidence to suggest that the fishery in Div. 3L was operating on several spawning components which spawn later inshore in Div. 3L, on the Southeast Shoal, and possibly in Div. 3Ps. It was recommended that only 10,000 t be reserved for a TAC of Div. 3Ps, since this stock was believed to be small, but that this amount could be taken in Div. 3NO if not taken in Div. 3Ps. It was concluded that it would be desirable to concentrate the fishery as

much as possible on the mature capelin in Div. 3NO to minimize potential adverse effects on capelin and other species. This would also reduce the possibility of overfishing any one of the spawning components present in Div. 3L earlier in the season and for the inshore spawning stock, it would minimize any adverse effect on the inshore migration and feeding success of the Div. 3L cod. The final subdivision of the 200,000 t TAC in the southern stock was no more than 10,000 t allocated to Div. 3Ps and no more than 50,000 t allocated to Div. 3L with the remainder allocated to Div. 3NO. If these maxima were not achieved in Div. 3L and 3Ps, the uncaught amounts could be taken in Div. 3NO (Anon. 1975).

The biological advice remained essentially unchanged until 1979 when evidence of poor recruitment in the capelin population resulted in a recommendation of reductions in the TAC's. STACRES advised that the 1979 TAC in Div. 3LNO should be 16,000 t and to protect the spawning stock in Div. 3N and during its migration through Div. 30 to Div. 3N, there should be no commercial fishery for capelin in Div. 3NO. This meant that 16,000 t could be taken only in Div. 3L. It was agreed by NAFO that there would be no offshore fishery for capelin in Div. 3L and Canada claimed only 10,000 t to be taken inshore. Therefore the quota for capelin in Div. 3L in 1979 was essentially 10,000 t. In the northern stock, it was recommended that the 1979 TAC be reduced from 300,000 t to 75,000 t.

The recruitment prognosis remained poor in 1980 and the biological advice remained unchanged for the stocks in Div. 3LNO that is, a TAC of 16,000 t with no fishing in Div. 3NO. In the north, the advice was to close the fishery or allow a small nominal TAC. It was noted that a small

fishery of 10,000-15,000 t in the north would allow scientists to better assess the status of the stock in 1980 and to quantify the advice for the next year. An experimental fishery with a TAC of 5,000 t was conducted in the fall of 1980 to provide data for assessment purposes.

In 1981 there was some evidence of improvement in the southern area and based on the exploitation rate that had been recommended in 1980 and 1981, a TAC of 30,000 t to be taken in Div. 3L was recommended while the Div. 3NO fishery should remain closed. In the northern area, there was conflicting evidence in the scientific data and as a result, the advice remained unchanged from the 1980 advice; that is, that the fishery remained closed or a small nominal fishery of 10,000-15,000 t be allowed. An experimental fishery with a TAC of 10,000 t operated in Div. 2J3K during the fall of 1981.

No scientific advice was requested for 1982. The TAC in effect for Div. 3L was 30,000 t, all to be taken inshore and no fishing was allowed in Div. 3NO. In Div. 2J3K an inshore quota of 3000 t was imposed while the offshore TAC for the experimental fishery was 10,000 t.

An assessment of the stocks conducted in mid 1982 (Anon. 1982) suggested that the stocks had improved dramatically, largely as a result of the strong 1979 year-class. The 1983 TAC recommended for the Div. 3L stock was 60,000 t and for the Div. 2J3K stock, 50,000 t. The offshore experimental fishery in Div. 2J3K operated again in 1983 with a TAC of 10,000 t. The quota management of the inshore capelin fishery has been determined by market considerations and the market demands have recently been somewhat lower than the biological TAC's. Consequently in 1983, the

1983 inshore TAC was 30,000 t in Div. 3L and 3000 t in Div. 2J3K. Although some improvement was detected in the Div. 3NO stock from surveys conducted In 1981, the abundance estimates were still much lower than historical estimates and it was recommended that this fishery remain closed in 1983.

According to assessments conducted in 1983 (Anon. 1983) the strong 1979 year-class would have disappeared from the population in 1984 and subsequent year-classes would not be as strong. This resulted in a recommended TAC of 38,000 t in Div. 3L. Again market considerations prevailed and the TAC set for management purposes for inshore Div. 3L was 26,000 t. In Div. 2J3K, the 1984 TAC level was recommended to be 100,000 t, an increase of 50,000 t over the recommended 1983 level. At first this advice seems in conflict with the prediction of smaller year-classes. However, in 1983, the TAC level was based on an exploitation rate of 10% of the predicted biomass. This 10% level had not been used previously (in fact, the level in 1982 was lower than 10%) for the Div. 2J3K stock but had been in effect for a number of years in Div. 3L. The TAC for the inshore fishery in Div. 2J3K was set at 3000 t in 1984 while the offshore TAC has been set at 16,700 t.

The biomass estimate in Div. 3NO from a survey conducted in 1982 still indicated that the capelin abundance was lower than historical levels. As a result, it was recommended that the fishery in 1984 remain closed.

B. Capelin in Div. 2J3K

As previously noted, the capelin fishery in Div. 2J3K was, until 1972, a small domestic inshore fishery, occurring during the spawning season of capelin when the fish were easily taken on the beaches. In 1972, substantial offshore catches were reported. These catches peaked in the mid 1970's and declined during the late 1970's. Since 1980 the only directed offshore catches have been taken in the experimental fishery. In recent years, a small directed inshore fishery has occurred.

In the offshore fishery, most of the catches were taken in September, October, and November although smaller amounts were taken in other months as well (Fig. 5). In some years, there has been a difference in timing of peak catches between Div. 2J and Div. 3K with the catches peaking in Div. 2J somewhat earlier in the years than in Div. 3K. Catches in most years were higher in Div. 2J and since 1979, the bulk of the catch has occurred in Div. 2J.

The inshore capelin fishery occurs in Div. 3K only and is directed at mature, spawning females which are of suitable quality in mid June to mid July for the Japanese roe market. Landings from this fishery have been low compared to inshore landings from Div. 3L (Table 1).

Assessment of the Div. 2J3K Stock

Because the commercial fishery in the 1970's was centred on capelin when they were offshore, most of the assessments related to this fishery and to this phase of their life cycle. More recently, the offshore fishery has declined while the inshore fishery has increased in importance

and as a result more data are being collected on the inshore fishery. There had been some studies on the biology of capelin (eg. Templeman 1948; Pitt 1958a, b; Winters 1966, 1970a, b) but detailed information on the population dynamics of capelin was not available during the early phases of the large offshore fishery. There have been a number of data sources used since the advent of the offshore fishery to assess the status of the stock. These have included a surplus production model, acoustics, a sequential capelin abundance model and catch per unit effort data. The use of the various data has shown a trend over time. During the early phase of the fishery, acoustic estimates and the surplus production model were the only sources of information. Both types of estimates were recognized as being crude but they were used as indications of the magnitude of the capelin resource. The surplus production model was used only in the early years of capelin assessments whereas the acoustic method has been used since 1974. As the fishery continued through the 1970's, there were enough data accumulated to develop the sequential capelin abundance model. This model was used up to 1981 to monitor stock status. The catch/effort data have been used as an indicator of stock status and were used to calibrate the sequential capelin abundance models.

The surplus production model was first developed in 1973 (Campbell and Winters 1973) and expanded in 1975 (Winters 1975; later revised by Winters and Carscadden 1978). Although it is extremely crude, the model was used to provide biological advice and was intended to provide a first estimate of potential long-term annual yield of capelin. It was recognized that many species of marine fish, mammals and seabirds feed

extensively on capelin and that the stocks of many of these predators had declined during the 1950's and 1960's. Therefore, it was assumed that there would be capelin available to a commercial fishery in the 1970's that previously would have been necessary to sustain the predator stocks. Cod, whales and seals were chosen for this analysis because there were estimates of their abundance and of capelin consumption (albeit crude in some cases) by these animals. The authors estimated that at depressed population levels, these predators consumed on average 3.585 million t of capelin per year. As a result of these calculations it was estimated that 1.25 million t of capelin would be available for a commercial fishery. The authors stressed that this estimate was crude and should only be interpreted as indicative of the order of magnitude of potential capelin yield under the assumptions used in the model. The authors suggested that the TAC should not exceed the lower limit of fluctuation in spawning stock size in view of the possibility of successively poor year-class survival. Based on estimates of fluctuations in spawning stock of Barents Sea capelin, the authors suggested that the TAC for capelin in Div. 2J3KLNO not exceed 250,000 t. The TAC that was eventually enforced was 500,000 t.

Other estimates of consumption of capelin have also been made. Minet and Perodou (1978) estimated that, based on average biomass estimates for cod during 1965-69 (before the large reduction in cod stock abundance), cod consumed 2.0-3.4 million t of capelin in Div. 2J3KL. In another study, Lilly et al. (1981) estimated that, based on projected cod stock size in 1980-81, the cod could consume 1155 to 3234 x 10^3 mt of capelin.

The sequential capelin abundance models (Miller and Carscadden 1979a; Carscadden and Miller 1980, 1981) were developed in an attempt to accommodate the high natural mortality that capelin exhibit. These models were used up to 1981; however, they have been abandoned since then as catches have been low. Estimates from the last run of the model used by STACFIS are given in Table 2.

Acoustic estimates, using echo integration, have been produced primarily by Soviet (Serebrov et al. 1975; Bakanev et al. 1976; Klochkov et al. 1977; Bakanev and Seliverstov 1978; Seliverstov and Serebrov 1979; Bakanev 1980, 1981, 1983) and Canadian (Miller et al. 1978; Miller and Carscadden 1979b; Carscadden and Miller 1980, Miller and Carscadden 1981; Miller et al. 1982, Miller and Carscadden 1983) scientists (Table 2) although one early estimate (Dragesund and Monstad 1973) was produced from an exploratory survey by the Norwegians. The Soviets have the longest time-series with the first estimate arising from a 1974 survey. The Canadian estimates were first produced from a 1977 survey, however, early Canadian estimates are not considered reliable by Canadian scientists. Estimates from surveys conducted since 1981 are considered reliable because of improved acoustic equipment and experience gained from earlier surveys. In recent assessments (Anon. 1982, 1983) acoustic estimates have been used as a basis for stock projections.

Catch rates (catch per hour) of USSR BMRT-type trawlers have been considered as a useful index of abundance. The catch rates from 1972-78 are from Seliverstov and Serebrov (1979) and from 1979 are from Canadian observers (Table 2). The 1979 and 1980 estimates were for the smaller

BMRT class trawlers while previous estimates were for the more powerful BMRT-A class trawlers. Details of the catch/effort data since 1979 are given in Table 3.

A summary of the various biomass estimates and catch/effort information is given in Table 2. Two of the series, the catch/effort data and the USSR acoustic survey, were indexed and are presented in Figure 6.

Although there are problems (i.e. unrealiability of some data or missing data) with each series of abundance indices (Table 1), they all show similar trends. Abundance was high during the mid 1970's, declined during the late 1970's and has increased in most recent years. These trends can be explained by substantial variations in recruitment. Two year-classes, the 1973 and 1979 year-classes, have been strong, accounting for the peaks in abundance in the mid 1970's and early 1980's. The year-classes between 1973 and 1979 were weaker and the biomass declined during the late 1970's. It seems probable that the 1969 year-class was also large, resulting in high biomasses in the early 1970's. The relative strength of the 1969 year-class is not apparent from the catch/effort data although the catch/effort data may be biased down in the early years because this was a new fishery. The estimates from the early USSR acoustic surveys and from the sequential capelin abundance models suggest that the biomass of capelin in the early 1970's was larger than the biomass in the late 1970's.

The presence of these relatively strong year-classes is generally supported by sampling data (Fig. 7). This figure illustrates that both the 1969 and 1973 year-classes were relatively strong in samples taken

from the fishery. Although the 1979 year-class appeared relatively strong in the offshore fishery as two-year-olds, other year-classes which were not known to be large also appeared relatively strong. It may be that age-compositions from this fishery in later years are not reliable indicators of relative year-class strength because of the drastic change in extent and distribution of the fishery. However, inshore sampling data from Div. 3K (Carscadden 1983) indicates that the 1979 year-class was very strong in the mature spawning stock in 1982 and relatively strong in 1983.

The changes in the offshore fishery may be affecting catch/effort estimates as well. There has been a substantial decline in catches and distribution of this fishery (Fig. 5). In most of the earlier years of the fishery, catches in Div. 3K were somewhat lower than in Div. 2J, but catches in Div. 3K have been almost non-existent since 1979. This change in the fishing pattern must raise some concern as to the comparability of catch/effort data pre- and post-1979. In fact, it was the decision of STACFIS (Anon. 1981) that the catch rate in 1980 was not a reliable indicator of stock abundance because the fishery was concentrated in a small area with fewer vessels for a shorter time period and was able to sustain a relatively high catch rate. Although this problem has not been identified since 1980, the distribution of the fishery has not changed although the catch levels have increased (because of increased quotas) and the catches have occurred over a longer time period.

During the years when catches were lower (1979 to present), the age-compositions in the catches were somewhat different from the period

prior to 1979. During the 1979-83 period, two-year-olds strongly dominated in three of the five years (1979, 1981, and 1982) and were strongly represented in the remaining two. Prior to 1979, two-year-olds dominated the age-compositions only in 1975 when the strong 1973 year-class was present in the fishery.

Age-compositions from the commercial inshore fishery were available for 1982 and 1983 (Table 4). The 1979 year-class which was strong in 1982 making up 84% of the landings as three-year-olds was still strong in 1983 comprising 37% of the landings as four-year-olds.

Age-compositions of mature spawning capelin from 1973-79 are given in Carscadden and Miller (1980), however these may be biased by poor sampling when the inshore fishery was predominantly for local use.

Logbook Analysis

Logbooks have been given to purse seine fishermen in Div. 3K since 1981 and to fixed gear fishermen since 1983. A detailed description of the logbook survey has been presented in earlier reports (Nakashima and Harnum 1982, 1983). The main emphasis of the logbook survey has been the Div. 3L fishery and it is only in 1984 that a concerted effort has been made to adequately sample in Div. 3K.

The inshore capelin fishery in Div. 3K is prosecuted by purse seiners and by fixed gear fishermen (beach seines and capelin traps). According to licencing records the number of purse seine licences has remained stable, whereas beach seine and trap licences have increased:

	Purse seine	Beach seine	Capelin trap
1981	44	90	0
1982	47	138	13
1983	43	186	27

The number of licences does not reflect fishing activity since the inshore fishery here tends to be opportunistic, i.e. according to the variable nature of capelin distribution in White Bay and Notre Dame Bay. Further when fishermen were required to obtain capelin licences for the first time in 1980, many fishermen applied for licences but have never landed capelin.

Discarding has been a major problem (Nakashima and Harnum 1982, 1983). In this analysis discarding refers to all capelin which are caught and not landed regardless of whether they are alive or dead. Dumping refers to dead capelin which are not landed. There has been considerable controversy over the magnitude of discarding/dumping which occurs during the fishery (eg. Anon. 1982). The reasons for discarding are varied but all are related to stringent quality demands for a particular frozen female product. The major reasons reported for discarding capelin by purse seiners (Table 5) and by fixed gear (Table 6) are presented. In 1980 most of the capelin released by purse seiners was due to a low female count, whereas the presence of redfeed has predominated in 1982 and 1983. In Div. 3L redfeed was recorded as the major problem from 1981-83 by purse seiners (Nakashima 1984). Similarly fixed gear fishermen in Div. 3K had to discard capelin because of redfeed, while a low count of females

was the most important reason reported in Div. 3L (Nakashima 1984). Data are available for the Div. 3K fixed gear fishery only in 1983.

Discarding from purse seines has increased from 13% of the reported logbook landings in 1981 to 22% in 1982 and 23% in 1983 (Table 7). Discarding from beach seines was reported as 28% of landings (Table 8) and from traps as 60% (Table 9) in 1983. The interpretation of the fixed gear data must be tempered by the small sample size.

Except for logbook records no catch/effort data are available for the inshore capelin fishery. The research logbook survey of the purse seine fishery began on a limited scale in 1981 (Nakashima and Harnum 1982) and of the fixed gear fishery in 1983. All indicators of purse seine catch/effort have increased from 1981 to 1982 and declined in 1983 (Table 7). This trend is similar to that for the Div. 3L purse seine fishery (Nakashima 1984). The Div. 3K trap catch/effort indices (Table 7) were lower than those for Div. 3L traps in 1983 (Nakashima 1984: L/D = 3.1, L/H = 2.8, C/D = 4.3, C/H = 3.8).

The Div. 3K inshore fishery is expanding as evidenced by higher landings in 1982-83 than in previous years, however, it is small compared to the Div. 3L fishery. Landings tend to be localized and subject to the vagaries of capelin distribution during the spawning season. Under the present system of market quota management and the limited number of plants which buy capelin in the area, landings in Div. 3K will continue to be considerably lower than in Div. 3L.

The research logbook survey has been intensified in 1984 to augment the number of fixed gear fishermen covered. The results from the 1983 survey are limited by a small sample size and the inexperience of fishermen in completing

logbooks. The purse seine logbook data are valuable for providing a minimum estimate of discarding, however, the utility of purse seine catch/effort data as abundance indices is uncertain (see Powles 1981).

For the moment the inshore commercial fishery is small. Current programs to collect inshore commercial samples for biological data and an improved logbook coverage of the fixed gear fishery should be sufficient to monitor the progress of the inshore commercial capelin fishery in Div. 3K.

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Table 1. Inshore capelin landings (t), 1974-83.

	Div. 3K	Div. 3L
1974	1031	4862
1975	751	2232
1976	1676	7813
1977	2136	8706
1978	2422	7439
1979	671	12282
1980	1354	14515
1981	1848	24397
1982	3896	27350
1983	3763	24992

Table 2. Summary of abundance estimates and abundance indices, September of each year, used in assessing the Div. 2J3K capelin stock.

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Catch/effort (t/hr)	2.81	3.29	4.56	6.47	5.27	4.14	2.29	1.34	4.57*	3.68	3.19	5.31
USSR acoustic (1000's t)			1334	982	749	506	59	14	20	-	611	
Canadian acoustic (1000's t)						42	14	10	-**	1794	-***	223
Sequential capelin abundance model	1987	2251	1848	4025	2843	1474	434	428				

* considered to be an overestimate
** some capelin found but too few to estimate biomass
*** capelin detected but equipment problems precluded an estimate

Table 3. Detailed catch and effort information from Div. 2J3K capelin fishery. All data from Canadian observer program.

Year	NAFO Div.	Month	Observed catch (t)	Observed hours	Catch rate (t/hr)
1979	2J	Sept.	191.1	194.8	0.98
		Oct.	2174.1	1375.2	1.58
		Nov.	779.5	815.6	0.955
		Total	3144.7	2385.6	1.32
	3K	Oct.	2178.9	1392.9	1.56
		Nov.	5.5	20.0	0.97
		Total	2184.4	1412.9	1.55
	TOTAL		5329.1	3798.5	1.40
1980	2J	Sept.	1594.7	302.2	5.26
		Oct.	3003.5	705.6	4.25
		Total	4598.2	1007.8	4.56
1981	2J	Sept.	1116.7	494.7	2.26
		Oct.	4584.6	1090.2	4.20
		Total	5701.3	1584.9	3.60
1982	2J	Aug.	324.5	134.1	2.42
		Sept.	2441.2	749.5	3.26
		Oct.	709.0	251.3	2.81
		Nov.	55.0	3.8	14.51
		Total	3529.7	1138.7	3.10
1983	2J	Sept.	1292.3	387.4	3.34
		Oct.	1884.3	254.3	7.41
		Nov.	818.0	132.7	6.16
		Dec.	360.0	45.2	7.96
		Total	4354.6	819.6	5.31

Table 4. Age-compositions (%) of capelin from the inshore commercial capelin fishery, Div. 3K, 1982-83.

	Age				
	2	3	4	5	6
Males					
1982	1.1	90.2	8.5	0.2	0.1
1983	0.2	65.0	34.8	0	0
Females					
1982	0.8	79.4	10.7	7.4	1.7
1983	0	44.0	52.6	3.4	0
Sexes combined					
1982	0.9	84.1	9.7	4.3	1.0
1983	0.1	62.4	37.1	0.4	0

Table 5. Reasons (expressed as % by weight) reported in logbooks for discarding capelin in Div. 3K from purse seines, 1981-83.

	Low % females	Redfeed	Not mature enough	Small females	Females spawned out	No. market	Unknown
1981	90	6	4	0	0	0	0
1982	32	52	0	10	6	0	0
1983	5	48	0	4	0	42	1

Table 6. Reasons (expressed as % by weight) reported in logbooks for discarding capelin in Div. 3K from beach seines and traps in 1983.

	Redfeed	Females over ripe	No. market	Low % females	Males picked out	Females spawned out
Beach seine	47	3	37	6	7	0
Trap	81	0	0	4	1	15

Table 7. Capelin landings (t), discards (t), and catch/effort for purse seines in Div. 3K, 1981-83.

	No. fishermen	Landings		Discards logbook	No. days fished (D)	No. sets made (S)	Landings		Landings & discards	
		Economics	Logbook				L/D	L/S	C/D	C/S
1981	10	533.9	725.0	92.9	89	118	8.2	6.1	9.2	6.9
1982	8	713.1	849.9	188.0	67	109	12.7	7.8	15.5	9.5
1983	14	808.2	1097.0	253.2	113	161	9.7	6.8	12.0	8.4

Table 8. Capelin landings (t), discards (t), and catch/effort for beach seines in Div. 3K, 1983.

No. Fishermen	Landings		Discards logbook	No. days fished (D)	No. sets made (S)	Landings		Landings & discards	
	Economics	Logbook				L/D	L/S	C/D	C/S
6	118.6	139.4	39.5	44	79	3.2	1.8	4.1	2.3

Table 9. Capelin landings (t), discards (t), and catch/effort for capelin traps in Div. 3K, 1983.

No. fishermen	No. traps	Landings		Discards logbook	Bycatch		No. days fished (D)	No. times hauled (H)	Landings		discards	
		Economics	Logbook		Cod	Herring			L/D	L/S	C/D	C/S
3	3	87.3	85.8	51.3	6.0	24.9	41	48	2.1	1.8	3.3	2.9

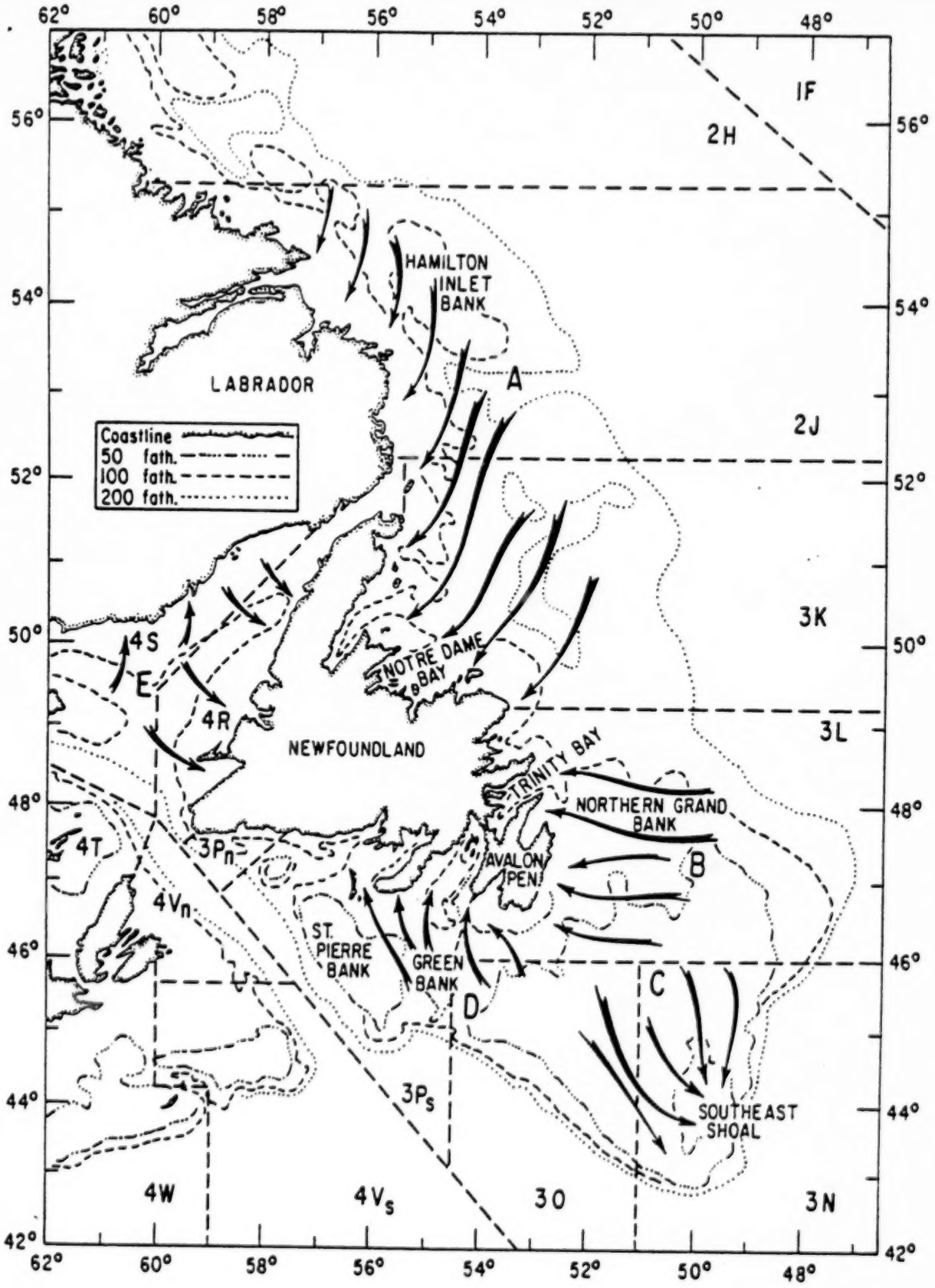

Fig. 1. Map showing major stocks of capelin in the Newfoundland-Labrador area. Arrows indicate the hypothesized migration routes of adult capelin to the spawning grounds.

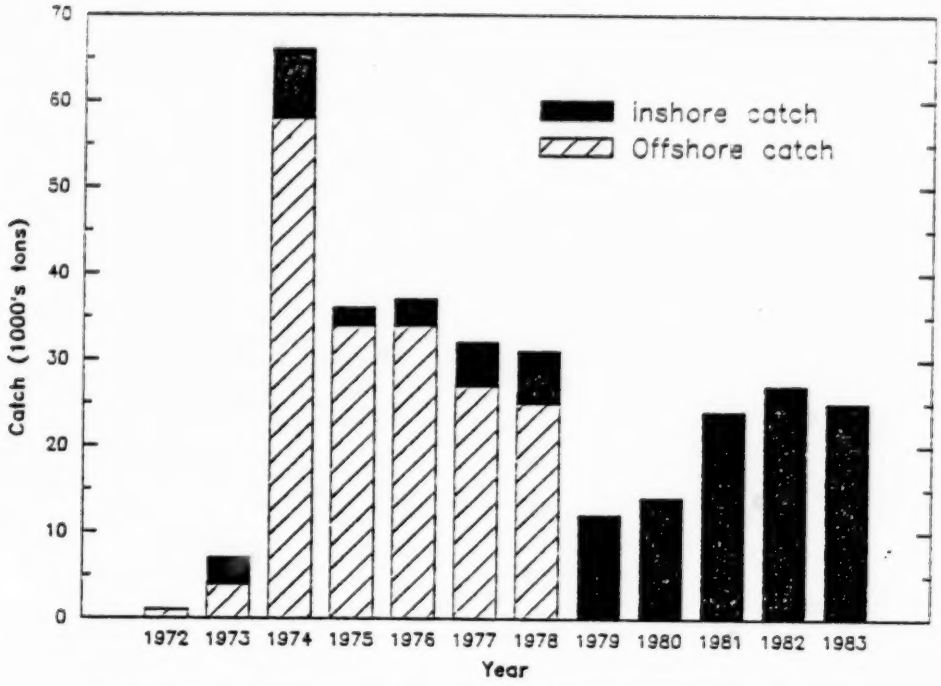

Figure 2. Catches from the 3L commercial fishery

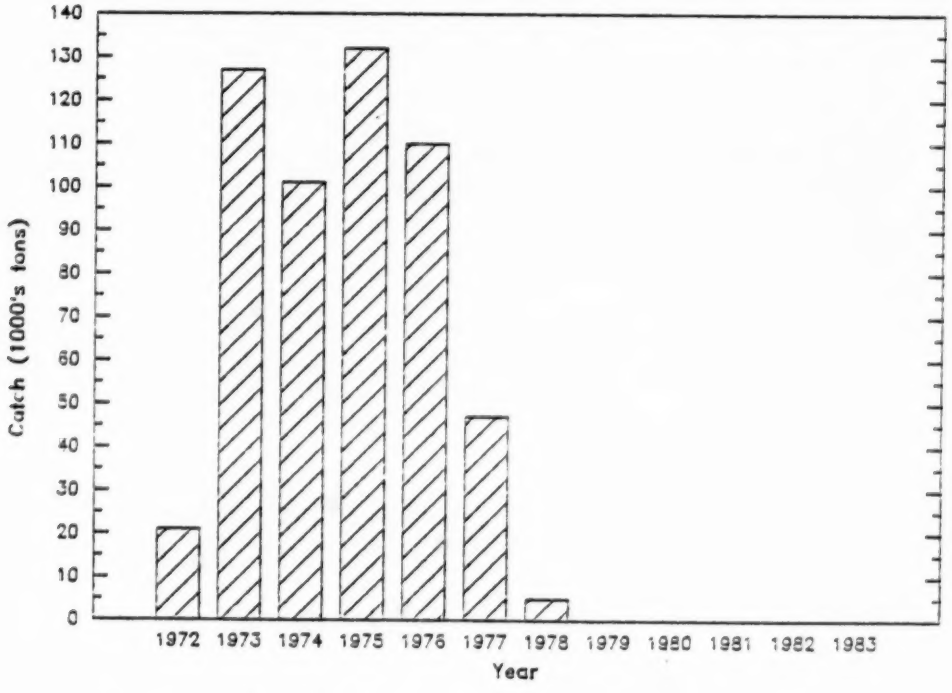

Figure 3. Catches from the 3NO commercial fishery

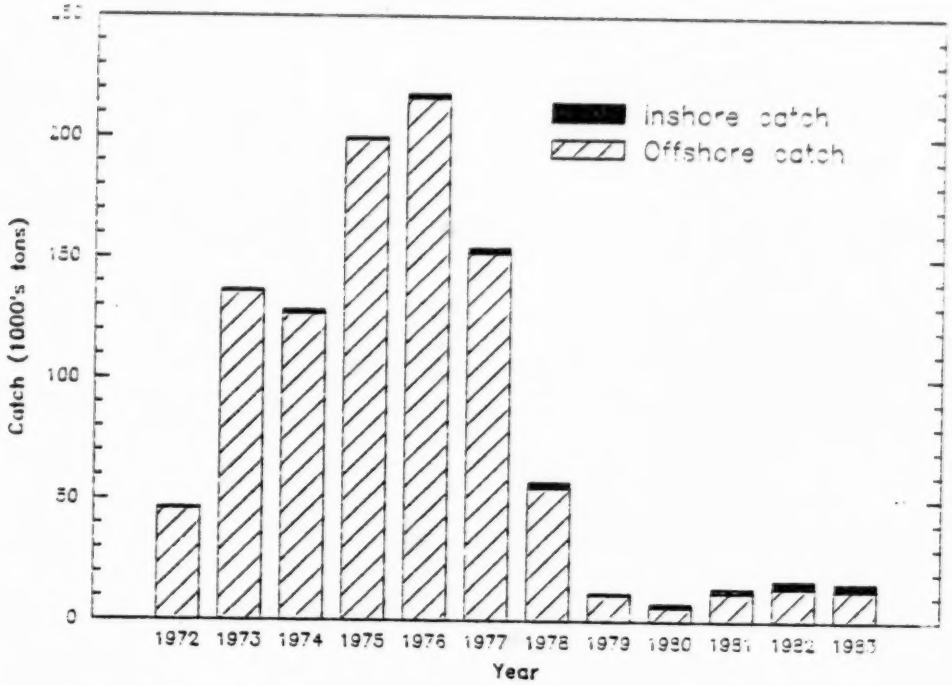

Figure 4. Catches from the 2J3K commercial fishery

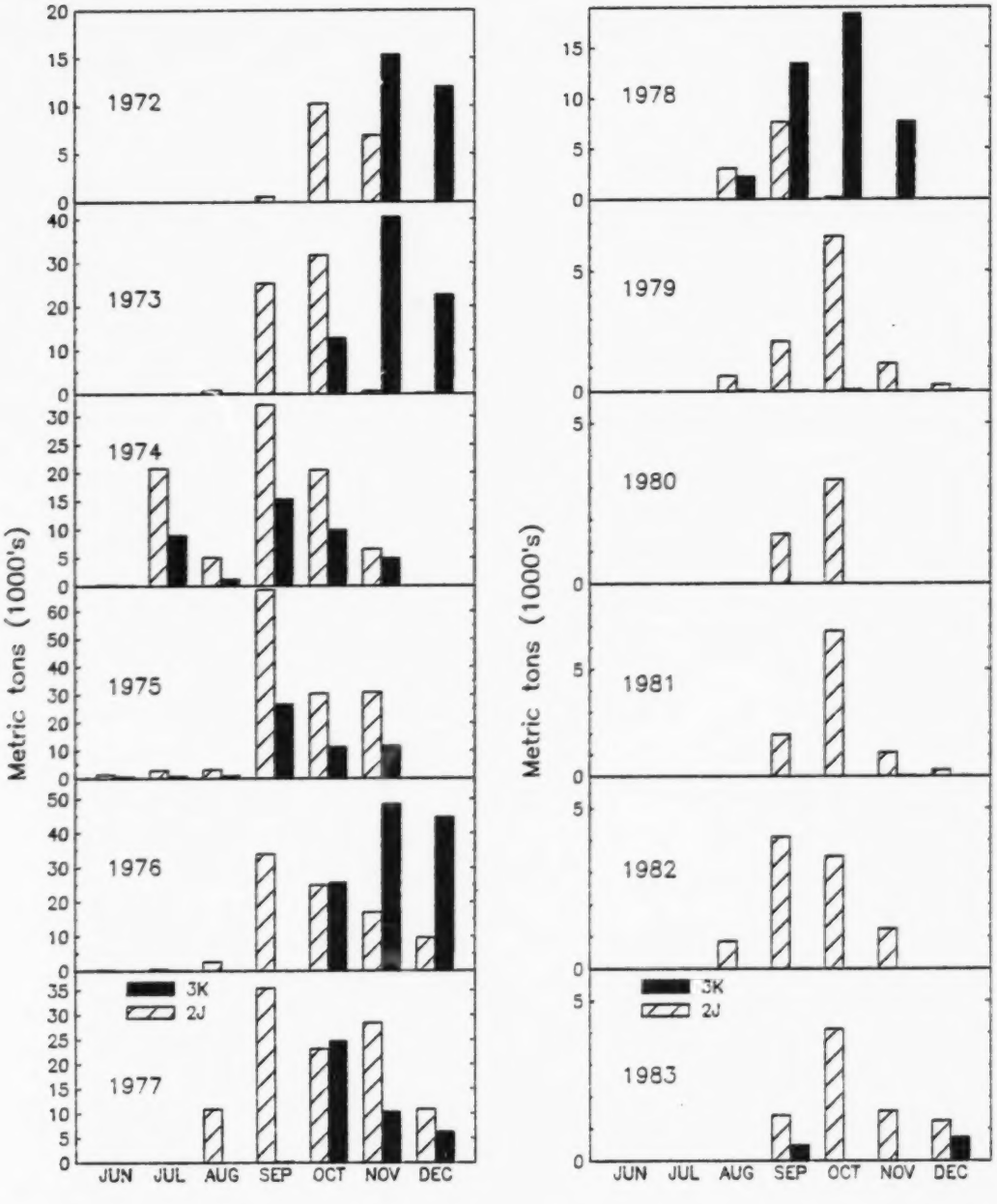

Figure 5. Catches from commercial offshore fishery 1972–1983

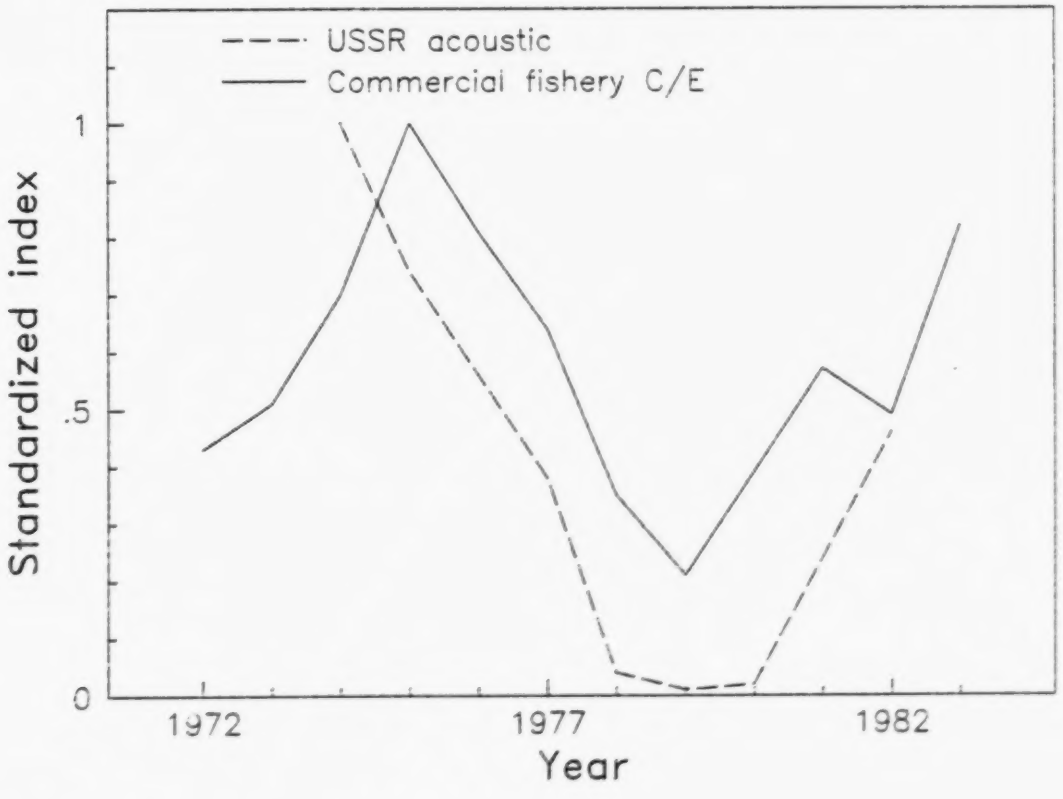

Figure 6. Standardized abundance indices from commercial C/E and USSR acoustic surveys

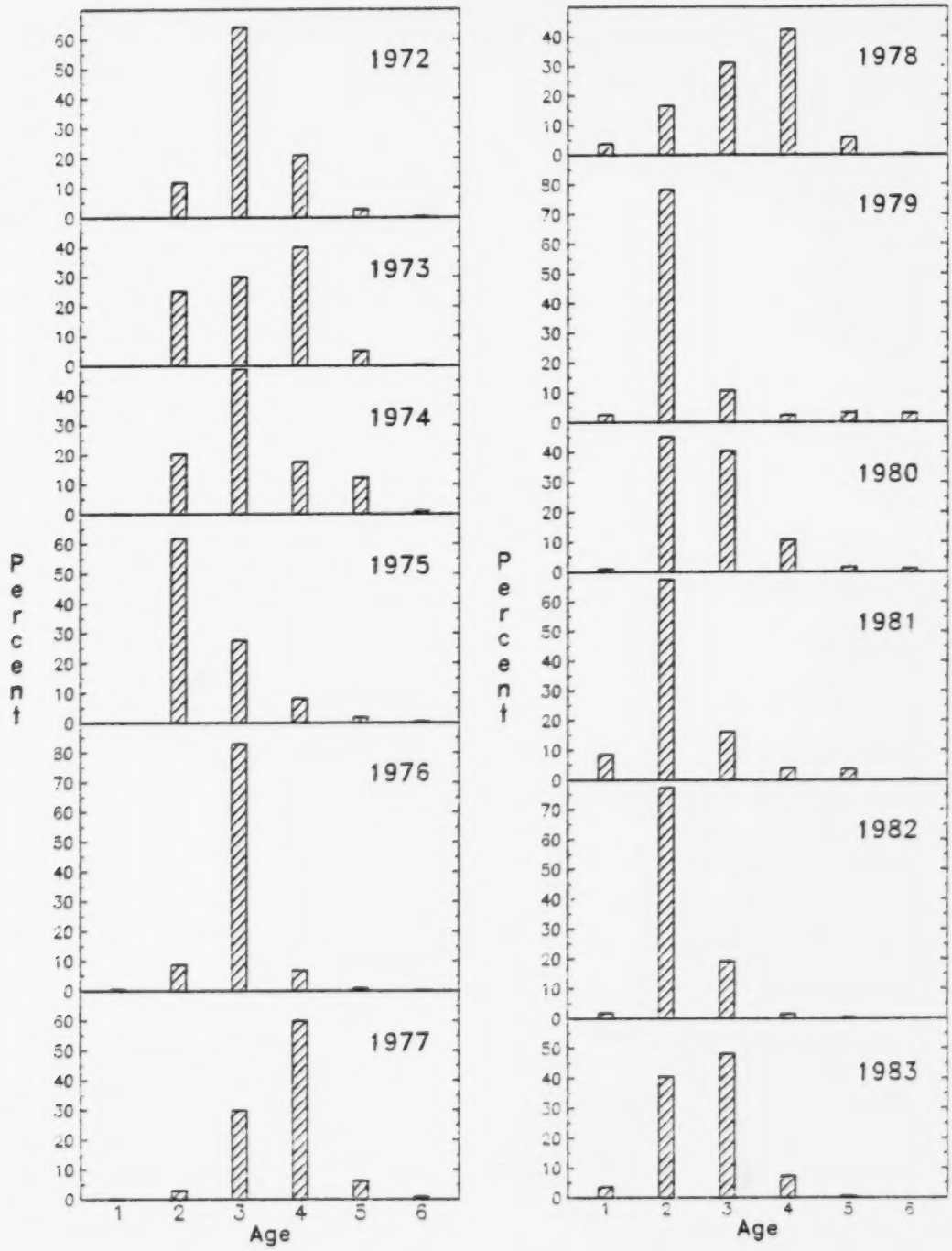

Figure 7. Age composition of commercial and experimental fishery. Divisions 2J3K 1972 – 1983